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DYE PROCESSING METHOD BY LASER IRRADIATION
[Reza shosha ni yoru senshoku kako-ho]

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Specification

1. Title of the Invention

Dye processing method by laser irradiation

2. Claims

(1) A dye processing method in dye processing including a process of applying heat setting to cloth consisting of thermoplastic synthetic fiber, characterized in that

it includes a process such that laser light in a wavelength region of selective absorption of said thermoplastic synthetic fiber is irradiated on the cloth being the object of processing to uniformly heat to a temperature being at or below the melting temperature of the thermoplastic synthetic fiber, set processing is applied, and then it is left to cool or force cooled.

(2) A dye processing method in dye processing applying permeation by the thermosol method to cloth consisting of thermoplastic synthetic fiber, characterized in that

it includes a permeation process in which the dye solution dispersed in the cloth being the object of processing is padded, then laser light in a wavelength region of selective absorption of said thermoplastic synthetic fiber is irradiated to heat the irradiated part, it is dried, and at the same time the dispersed dye is diffused and fixed inside the fiber.

(3) A dye processing method as defined in Claim (2), wherein the laser light is uniformly irradiated on the entire region of the cloth.

(4) A dye processing method as defined in Claim (2), wherein the laser light is irradiated in a spotty pattern or non-uniformly such that it is diffused in a gradation from the center of irradiation to the periphery.

(5) A dye processing method in dye processing applying printing by the thermosol method to cloth consisting of thermoplastic synthetic fiber, characterized in that

it includes a printing process in which printing with printing glue is applied to the cloth being the object of processing, then laser light in a wavelength region of selective absorption of said thermoplastic synthetic fiber is irradiated to heat the irradiated part, it is dried, and at the same time the printed part is fixed by dry heating.

(6) A dye processing method as defined in Claim (5), wherein the laser light is uniformly irradiated on the entire region of the printed part of the cloth.

(7) A dye processing method as defined in Claim (5), wherein the laser light is irradiated on the printed part of the cloth in a spotty pattern or non-uniformly such that it is diffused in a gradation from the center of irradiation to the periphery.

(8) A dye processing method as defined in Claim (5), wherein the laser light is irradiated after having applied a specified masking to the printed part of the cloth.

3. Detailed Explanation of the Invention

The present invention attempts to achieve improvement of a dye processing method, more specifically improvement of a dye processing

method including a setting process, permeation process, or printing process, by skillfully utilizing laser light having ease of directional control as a means for heating of the process fiber in the dyeing process and controlling the thermal energy contained in this according to intention.

In the dyeing process of cloth and the like, using synthetic fiber such as polyester or regenerated fiber such as diacetate and triacetate, set processing is generally employed for stabilization of the cloth in the dyeing process, setting of the width and length of finished products, stabilization of manufactured products, rectification of cloth resumes, and the like, and various forms of setters are provided so as to apply the desired setting processing according to the type of fiber and the use of the product. Particularly in a heat setter, hot blowing is commonly used, and there were difficulties that the energy equipment was large and the energy loss was great, and fine temperature control and selective control of the heated and non-heated locations were impossible.

Also, in permeation and printing, the thermosol method has been employed when batch dyeing a comparatively large quantity of cloth, but there were drawbacks that it was by no means beneficial from the aspect of energy efficiency because it involves a process of further processing with dry heat at high temperature after once having dried the dye solution padded in the cloth, and moreover the equipment became very large and at the same time the thermal distribution during intermediate drying and high-temperature processing tended to become non-uniform.

The present invention was created in consideration of the fact that

there were drawbacks such as the abovementioned in the setting process, permeation process, and printing process in the dyeing processing of the past, and it is the realization of an epoch-making dye processing method that vastly improves energy efficiency while being extremely easy in temperature control and selective control of heated parts and non-heated parts, through paying attention to the optical properties of laser light, particularly that of CO_2 lasers and utilization of its thermal energy component as a heating source in the abovementioned process.

Incidentally, methods of irradiating infrared light as a heating system have been proposed in the past as well, but there is a difficulty that the rate of dispersion and dilution of the thermal energy into the air is great and the thermal efficiency is not sufficiently satisfactory because the propensity of irradiation of infrared light is diffuse. On the other hand, laser light represented by the CO_2 laser has the advantages that it is composed of parallel invisible thermal radiation, the precise heating effect can be obtained in the intended locations by being selectively absorbed by synthetic fibers such as polyester and regenerated fibers such as diacetate and triacetate without incurring dispersion of the thermal energy in the air, and amazingly it can heat instantly at start-up virtually without requiring preheating time. Moreover, laser light is characteristic in that it has the advantage that it can heat by irradiating only the desired part because the directionality is fine and the extent of exposure or diffusion is easy to adjust using a lens, so graded or spotted dyeing becomes possible particularly in the permeation or printing process.

Below, examples of use for the setting process, permeation process,

and printing process in dye processing are explained in detail based on specific examples.

Working Example 1 (Example of Use in Setting Process)

A CO_2 laser 1 of product name LAAKMAN RF160 (50 W) was used, and as shown in Figure 1, the optical path was diverted downward by a reflective mirror 2, it was passed through a diffusing optical system 3 (a convex lens may also be used for defocussing), it was scanned on a woven cloth consisting of polyester thread (manufactured by Toray Inc., product name: baresukurebu [as transliterated]) in extended state, laser light of average energy concentration 3.1 W/cm^2 [legibility uncertain] and diffused to a diameter of 4.5 mm was irradiated for an average of 1 second on its surface, and after that, a cold blast of about 20°C was blown for 5 seconds to perform setting processing. As a result, compared with the method of the past (setting processing in which, after predrying, heat processing is performed for 30 seconds at 150-200°C using a heat setter manufactured by Hirano Metals Co., and a cold blast of about 20°C is blown for 3 seconds), the processing time was abridged to as far as 1/5 to 1/6, and moreover the energy consumption showed amazing energy conservation at 50 W/h.

Working Example 2 (Example of Use in Permeation Process)

The laser irradiation mechanism shown in Figure 1 was used, baresukurebu made of polyester thread (that applied with setting processing in Working Example 1) was applied with padding processing using the padding solution noted below, then this was scanned in extended state, laser light of average energy concentration 3.1 W/cm^2 [legibility uncertain] and diffused to a diameter of 4.5 mm was

irradiated on its surface for 1 second to disperse and fix the dispersion dye in a moment, furthermore the unfixed dye and dispersing agent were completely removed through a soaper, and the permeation process by the thermosol method was completed.

By that permeation process, compared with the method of the past (the thermosol method in which, after padding, it is dried for 20 seconds with a non-touch dryer being a dryer for intermediate drying, and processing for 30 seconds is performed using a pin system tenter-type heat setter), where coloration by the method of the past required 30 seconds, the same extent of results was obtained with the present method at 1 second of processing.

Composition of Padding Solution

Dispersion Dye	1
Gluing Agent (Low-Viscosity Sodium Alginate)	1
Malic Acid	1.5
Water	96.5

Working Example 3 (Example of Use in Printing Process)

The laser irradiation mechanism shown in Figure 1 was used, baresukurebu made of polyester thread (that applied with setting processing in Working Example 1 or that applied with permeation processing in Working Example 2) was printed with a desired pattern using the printing glue composition noted below, laser light of average energy concentration 3.1 W/cm^2 [legibility uncertain] and diffused to a diameter of 4.5 mm was irradiated for 3 seconds to dry immediately and at the same time to fix by drying, after that it was washed with water to remove the unfixed dye gluing agent and adjuvants, and reduction

cleaning was performed, thereby completing the printing process.

In the case by this printing process, compared with the method of the past (the thermosol method in which the printed cloth is drying processed for 30 seconds with a hot blast of 180°C or more, or a method in which it is processed at atmospheric temperature for 5 minutes with a high-temperature steamer using atmospheric-pressure overheated steam of a 175°C HT steamer), superior results were obtained in which that of equal or higher quality was obtained in finishing, and the energy conservation was incomparable. The printing glue composition was made by mixing solution A and solution B of the compositions noted below in a 7:3 proportion and having dispersion dye uniformly dispersed therein so as to become 2%.

(A Solution)

Fine Gum HEL (Daiichi Kogyo Seiyaku)	
CMC...	6 parts
Sorbitase C-5 (Avebe)	
Processed Starch...	4 parts
[Duck] Algin (Kamogawa Kasei)	
Algin...	2 parts
Tartaric Acid	0.5 parts
Chlorate of Soda	1 part

(B Solution)

Tarpene	60 parts
Water	24 parts
Lyoprint EV (nonionic)	16 parts

Above, methods of utilizing lasers in dyeing processing pertaining

to the present invention were explained using working examples, but the present invention is not limited to the abovementioned working examples, and various modifications are possible.

For example, in the working examples, woven cloth made of polyester thread was used, but it can be applied in the same manner also to woven cloths of regenerated fibers such as diacetate and triacetate, and other thermoplastic fibers.

Also, in the working examples, CO_2 laser light (wavelength 10.6 μm) was used, but other laser light, that is, solid lasers, also can be used. However, it must be in the wavelength region of efficient absorption by the irradiated fiber, and it is desirable that it be set to an average energy concentration of 1-10 cm^2 [legibility uncertain] in that irradiation region so that the desired heat setting processing can be applied.

Furthermore, in the working examples, it was such that the diffusion laser light was irradiated on the cloth scanned by, but it may also be made such that spot irradiation regions are scanned in parallel at a specified speed, and a method in which coloration spots are made to appear in a planned manner, utilizing the fact that the energy concentration becomes non-uniform when the laser light generated from the light source is irradiated on the surface of the cloth being removed from the optical axis of the optical lens, naturally can be employed.

4. Brief Explanation of the Figure

Figure 1 is a schematic drawing representing one example of a diffusion laser beam irradiator.

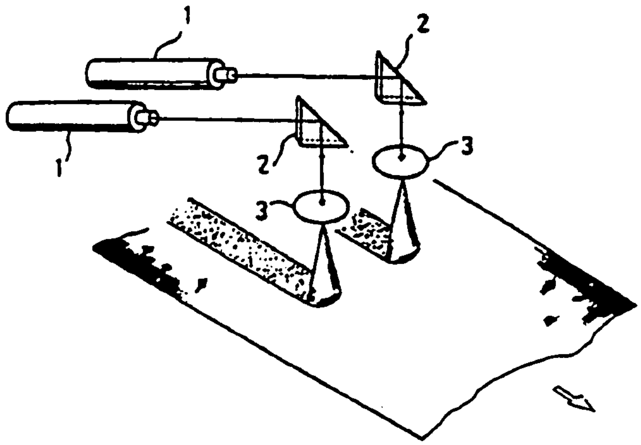

Figure 1